MGMTMFE 400 Investments

Project for Lecture 4

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Executive Summary

Yield curve spread trades provide a wide variety of market participants the opportunity to generate returns and effectively hedge portfolios. We review the yield curve spread trade mechanics and execution of a flattener strategy using 2-year and 10-year zero coupon Treasury bonds. We have taken the daily U.S. Treasury yield data from Federal Reserve Board website for 2 year and 10 year zero coupon bonds. This has the daily parameters needed to calculate the yield of any maturity bond by the Nelson-Siegel-Svensson yield curve model. The time period for analysis is 30th December 1983 to 30th June 2017.

We start with $1 million in initial capital and have 10% capital requirement in our trading positions. We setup a DV01-neutral yield curve spread trade by longing the 10-year Treasury bond (Back leg) and shorting 2-year Treasury bond (Front leg). This will essentially lead to flattening of the yield curve. We rebalance our portfolio every week. We earn interest on the cash position which is the value of the short position minus the value of the long position plus the amount of capital held against these positions. We assume one-week Treasury yield as the interest rate.

We close out our positions every week and invest the capital at the end of the week (initial capital + portfolio revenue + interest) and rebalance our portfolio. We continue this process every week till June 30th 2017.

Introduction

The yield curve is used as a leading indicator of future economic activity. Its slope is influenced heavily by the central bank's' monetary policy and expected inflations. The Fed increases or decreases rates either to cool down overheated economies or to provide stimulus. With yield curves, a yield curve spread can be created. A yield curve spread shows the yield differential between two different maturities of a bond issuer. When it is compared to historical trends, it can be used to indicate how market participants view economic conditions and gives the opportunity to generate returns and effectively hedge portfolios.

In this project, we use 10-year and 2-year U.S. Treasury zero coupon bonds. The 10-year U.S. Treasury bond leg of the trade is referred to as the back leg and the 2-year U.S. Treasury leg of the trade is referred to as the front leg. There are two primary yield curve spread strategies: the flattener and the steepener. We choose the flattener strategy where we short and long 2-year and 10-year US Treasury Bonds. We have an initial capital of $1 Million Dollars in the beginning, which we keep as collateral with the broker. As the fixed income bonds can be highly leveraged, we get $10 Million worth of capital to invest in. We start on 12/30/1983 and unwind the trade on 06/30/2017. Every week, we close our position and reinvest any profit or loss, provided our collateral remains 10% of our investment. The aim of this trade is to choose the number of bonds to short or sell in such a way so as to maximize the profits.

Discussion

Part 1: Building the Yield Spread

Yield Curve is nothing but the term structure of the spot rates. To calculate the weekly spot rates, we use The Nelson-Siegel-Svensson Formula, which is given by:

$$r_t = \beta_0 + \beta_1 \frac{(1 - e^{-t_1})}{t_1} + \beta_2 \left[\frac{(1 - e^{-t_1})}{t_1} - e^{-t_1}\right] + \beta_3 \left[\frac{(1 - e^{-t_2})}{t_2} - e^{-t_2}\right]$$

$$\text{where, } t_j = \frac{T}{\tau_j}$$

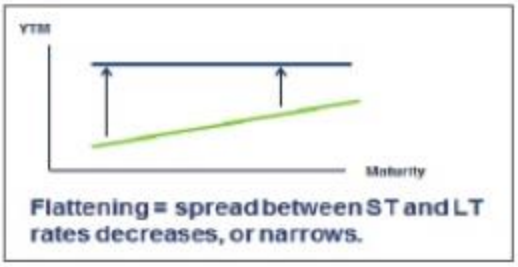
For our analysis, we build the yield spread by taking the daily spot rates generated by the above model for 2-year and 10-year zero coupon bonds.

Part 2: Yield curve Strategies

A yield curve spread is the yield differential between two different maturities of a bond issuer i.e. 10 year U.S. Treasury yield – 2 year U.S. Treasury yield. The later maturity leg of the trade is referred to as the back leg and the trade leg maturing earlier is called the front leg. Two primary yield curve spread strategies are the "flattener" and the "steepener."

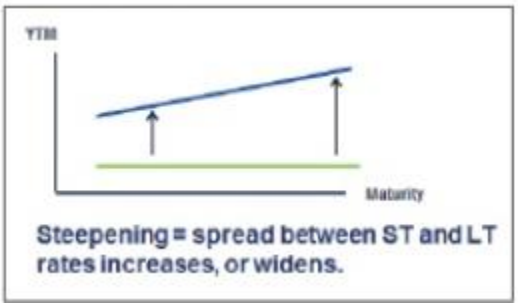
<u>Yield Curve Spread Flattener</u>

The flattener makes money when the yield differential decreases, or narrows. Sell the spread to put on a flattener. So, the flattener strategy short the front leg and long the back leg.



Yield Curve Spread Steepener

The steepener makes money when the yield differential increases or widens. Buy the spread to execute a steepener. So, the steepener strategy long the front leg and short the back leg.



We have chosen the Flattener Strategy for our analysis

Part 3: Hedging the portfolio

Next, we use the following 2 equations to hedge our position against changing yields and find the weights

1. $DV01_{2year} * |W_2| = DV01_{10year} * |W_{10}|$
2. $0.1 * [\,|W_2| * P_2 + |W_{10}| * P_{10}] = CAPITAL$

where,

$\boldsymbol{W_2 = \ number\ of\ 2\ Year\ Treasury\ Bonds\ to\ short}$

$\boldsymbol{W_{10} = number\ of\ 10\ Year\ Treasury\ Bonds\ to\ buy}$

This is done every week and hence weights change every week, and portfolio gets rebalanced.

Part 4: Rebalancing

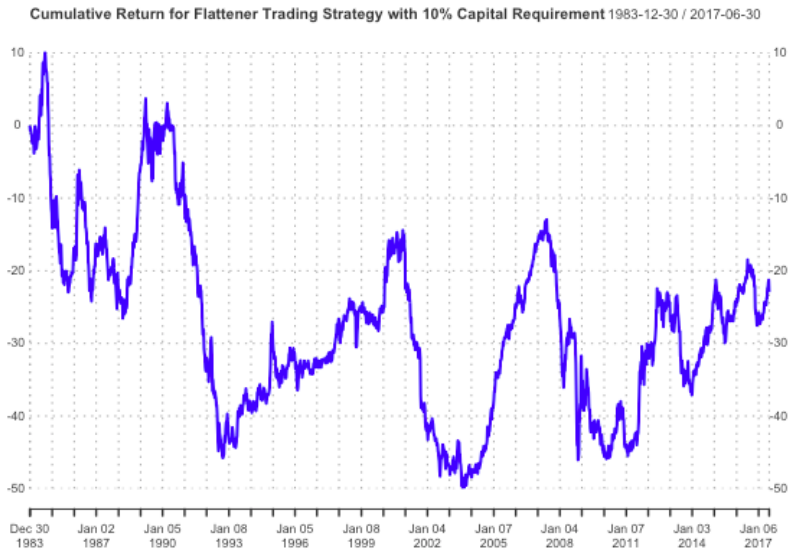
Initially, we start with $1 million of capital. After every week, we close our positions and our new capital is given by-:

$$\boldsymbol{NEW\ CAPITAL = Last\ Week\ Capital \pm Capital\ Gain\ (loss) + Interest}$$

The Cash Position after every week, is given by value of short position *minus* value of long position *plus* the margin.

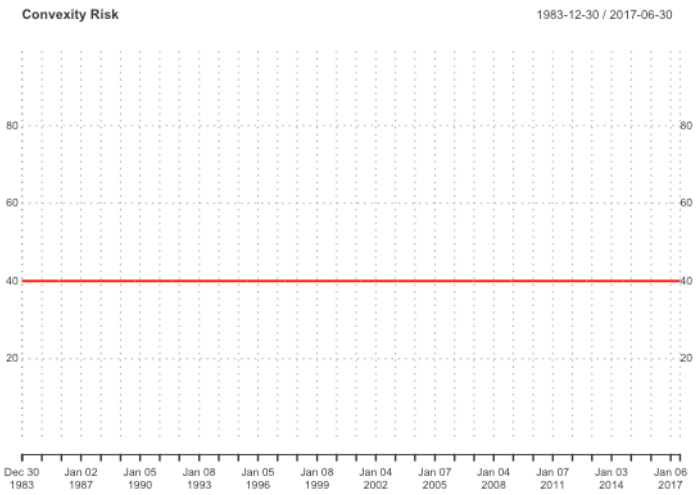
Conclusion

The cumulative return for the flattener strategy is shown as:



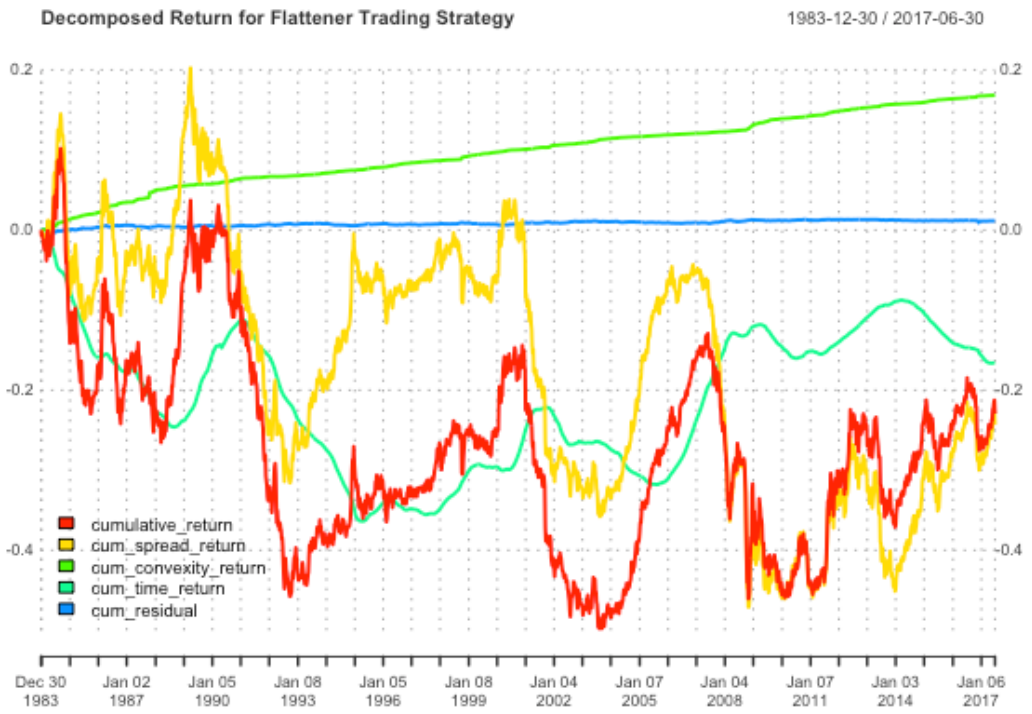
As we can see from the graph, the cumulative return using the flattener strategy. The total return coincides with dotcom bubble bust in early 2000s and financial crisis in 2008 where the yield curve steepens. Flattener strategy loses money when the yield curve steepens.

Although the spread trade is DV01-neutral, there is unhedged convexity. So, we calculated the convexity risk of the spread trade for a 10-basis point change in yields for a constant $1mm position in the 10-year Treasury and the convexity risk over time is shown below.



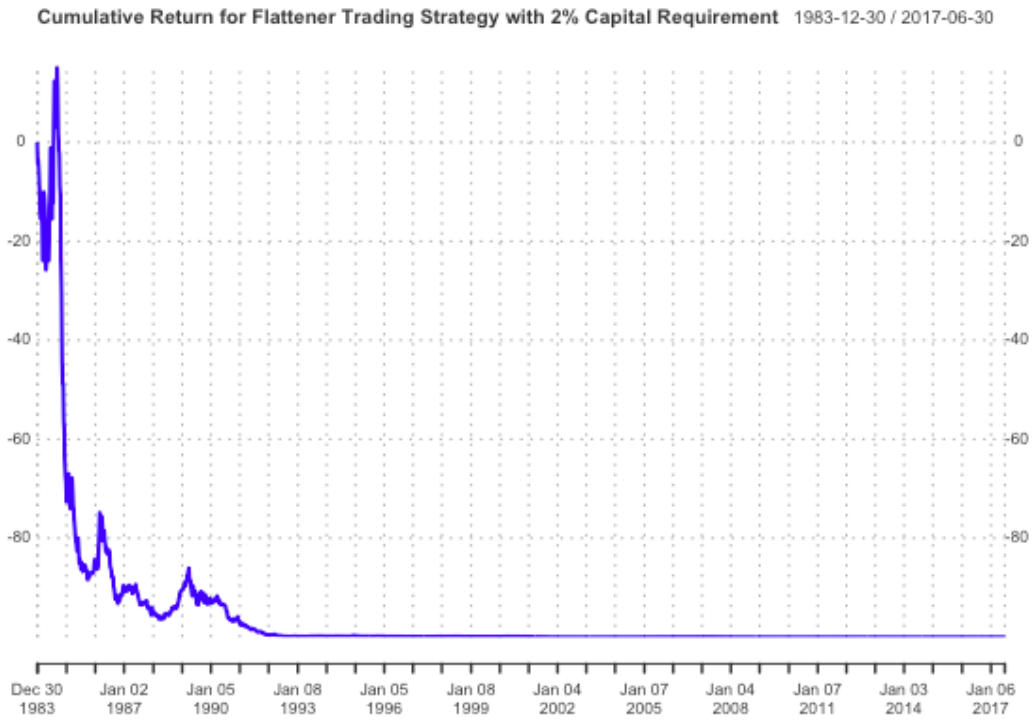
The convexity risk is constant because it is not a function of bond price due to the characteristics of continuous compounding.

We calculate the duration and convexity for each leg of your trading strategy for each day. Given our risk metrics, the changes in yields, and the size of your positions, decompose the weekly return into the spread return, convexity return and time return, shown as follows:



The decomposed return is reasonable because the residual return is significantly small. The residual return is the difference between the theoretical return compositions (sum of spread return, time return and convexity return) and the total return calculated using the data. The small residual return indicates that the strategy we used is implemented correctly.

We also plotted the cumulative total return of the 2% margin requirement.



Compared to the 10% margin requirement, the cumulative total loss of the 2% margin requirement is extremely high because the leverage ratio is 50 compared to 10 before. So the loss is amplified 5 times.